MIL-P-17869A(SHIPS)
24 May 1956
SUPERSEDING
MIL-P-17869(SHIPS)
24 March 1954

MILITARY SPECIFICATION

PUMPS AND MOTORS, POWER, OIL HYDRAULIC

(NAVAL SHIPBOARD USE)

1. SCOPE

1.1 Scope.- The specification covers pumps and hydraulic motors for use as components of Naval shipboard machinery such as steering gear, cranes, elevators, winches, windlasses and hoists.

1.2 Classes.- Pumps and motors shall be of the following classes as specified (see 6.2):

Class I - Axial multiple piston, fixed or variable delivery.
Class II - Radial multiple piston, fixed or variable delivery.
Class III - Vane, fixed or variable delivery.
Class IV - Gear, fixed delivery.
Class V - Screw, fixed delivery.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, and publications, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

FEDERAL
QQ-I-662 - Iron Castings, Gray.

MILITARY

JAN-P-735 - Primer, Paint, Zinc-Chromate, Alkyd Type.
MIL-S-901 - Shockproof Equipment, Class HI (High-Impact), Shipboard Application, Tests for.
MIL-D-963 - Drawings, Production (for Electrical and Mechanical Equipment for Naval Shipboard Use).
MIL-O-6083 - Oil, Preservative, Hydraulic Equipment.
MIL-L-15017 - Lubricating Oil, Hydraulic.
MIL-I-15017 - Identification Plates, Information Plates and Marking Inform action for Identification of Electrical, Electronic and Mechanical Equipment.
MIL-T-15071 - Technical Manuals for Mechanical and Electrical Equipment.
MIL-E-15090 - Enamel, Equipment, Light-Gray (Formula No. 111).
MIL-R-15137 - Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).
MIL-P-16789 - Preservation, Packaging, Packing and Marking of Pumps General, and Associated Repair Parts.
MIL-I-17166 17166- Iron Castings; Nodular Graphitic (Ductile Iron) (for Shipboard Applications).
MIL-F-17292 - Format for List of Repair (Spare) Parts for Shipboard Mechanical and Electrical Equipment.
MIL-L-17331 - Lubricating Oil, Turbine (Noncorrosive).
MIL-I-17414 17414 - Impregnation of Porosity in Copper-Base alloy Castings, Process for.

NAVY DEPARTMENT

General Specifications for Inspection of Material.
42135- Bearings, Ball.
42B10 - Bearings, Roller.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-130 130- Identification Marking of U. S. Military Property.
MIL-STD-167 - Mechanical Vibrations of Shipboard Equipment.

PUBLICATIONS

BUREAU OF ORDANCE

NAVORD OSTD63 - Piping, Tubing, and Fittings for Hydraulic Equipment.

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

2.2 Other publications.- The following document forms a part of this Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply:

NATIONAL BUREAU OF STANDARDS PUBLICATION

Handbook H28 - Screw Thread Standards for Federal Services,

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.).

3. REQUIREMENTS

3.1 Qualification.- The pumps and motors furnished under this specification shall be products which have been tested and have passed the qualification tests specified herein (see 6.2).

3.1.1 Manufacturers submitting pumps or motors for qualification testing shall include complete technical data on performance, materials and a set of outline and assembly drawings.

3.2 Material.- All materials shall be suitable for the purpose intended and shall be in accordance with or equal to the applicable specification specified in section 2. Nodular iron and "mechanite" castings in accordance with Specifications MIL-I-17166 and QQ-I-652 respectively shall be considered for pump and motor cases, end caps, covers, bases, and similar items. Castings shall be clean, homogeneous and entirely suitable for oil hydraulic power transmission service. Impregnation of nonferrous castings for the purpose of sealing minor porosity will be given consideration upon application to the bureau or agency concerned for permission to use the process. The impregnation process, where used shall be in accordance with Specification MIL-I-17414.

3.3 General design.-

3.3.1 Sizes.- Pumps and motors shall be furnished in sizes as specified (see 6.1).

3.3.2 Pumps and motors shall be suitable for either standard or heavy duty service. Standard duty shall render a minim urn varying service of 5000 hours Heavy duty shall render a minim urn varying service of 10,000 hours (see 6. 1).

3.3.3 Ruggedness.- Pumps and motors shall be of substantial construction, Design shall be in accordance with best m odern engineering practice, There shall be no excessive vibration of moving parts under any conditions of operation up to and including 115 percent of rated speed. Pumps and motors shall operate without loss in performance at any position from normal up to 30 degrees either side of normal, such positions being due to roll of the ship on which the equipment is installed.

3.3.4 Factor of safety.- Stresses under normal full-load condition shall not exceed 35 percent of the minimum urn yield point of the material used and, under extreme loading (for example, impact loading) the combined stresses shall not exceed 70 percent of the minim urn tensile yield point (t.y.p.) of the material used. The following yield points may be assumed:

(a) Direct shear -60 percent t.y.p.
(b) Torsional shear -60 percent t.y.p.
(c) Static bearing -160 percent t.y.p.

3.3.5 Mounting. -

3.3.5.1 Pumps.- Pumps shall. be designed to be base or flange mounted as specified (see 6.1).

3.3.5.2 Motors.- Unless otherwise specified in the contract or order, hydraulic m motors shall be designed for flanges or bracket mounting direct to a reduction gear case or to the supporting structure of the driven member of the assembly (see 6.1).

3.3.6 Bearings.- In general, all anti-friction bearings used in pumps and motors shall comply with Specifications 42B5 and 42B10, as applicable. The exception will be the rotating element in class I and II pumps where a special type bearing may be required.

3.3.7 Drive shafts.- Splined or keyed drive shafts shall be furnished as specified (see 6.1) or in the applicable machinery purchase specifications, Shafts shall project sufficiently to permit attachment of a coupling, drive gear or pinion of a size suitable for the particular pump or motor. Keys shall be furnished with keyed drive shafts.

3.3.8 Direction of rotation.- All pumps shall be designed to rotate in a clockwise direction unless otherwise specified in the contract or order. All motors shall be designed for reversing service. Rotation shall be determined while facing the drive shaft of the unit.

3.3.9 Operating speeds.- Pump drive speeds shall be the highest practicable for the particular size and type. Speeds shall be selected on the basis of providing for direct coupling of the pump to its prime mover and minimumization of space requirements. Hydraulic motor speeds shall be consistent with the speed of pumps of the same type and size.

3.3.10 Parts clearances and interchangeability.- Clearances between all working parts shall be sufficient to insure satisfactory operation between the minimum and maximum temperatures specified in 3.3.13. Parts, assemblies and subassemblies shall be interchangeable between units of the same class, size and manufacture.

3.3.11 Fastenings.- AU threaded fastenings used to secure one part of a hydraulic pump or motor to another shall be American National form and fit in accordance with Handbook H28.

3.3.12 Pipe connections.- All suction, discharge and drain ports through the case or end cover of pumps and motors shall terminate in bosses cast on the case or cover. Bosses shall be suitably finished for attachment of square or rectangular male type flanges. Flanges and seals for each connection shall be furnished by the pump or motor manufacturer and shall be in accordance with Publication NAVORD OSTD63.

3.3.12.1 Pipe connection sizes.-

3.3.12.1.1 Pumps.- Size of pressure ports and pipe flanges at normally rated output shall be such that velocity of the hydraulic fluid through the connected pipe will not exceed 20 feet per second. Suction ports shall be of a size to permit entry of fluid at a velocity of not more than 5 feet per second at normally rated output. Where a pump is used in a closed hydraulic power transmission circuit and the pump intake is supercharged or replenished, suction and pressure ports may be of the same size, that is, that which will limit fluid velocity to 20 feet per second.

3.3.12.1.2 Motors.- Pressures and discharge ports shall be of a size that will limit fluid velocity in and out of the motor to 20 feet per second at normal rated speed.

3.3.13 Operating temperature range.- Pumps and motors shall operate satisfactorily at fluid discharge temperatures between 0 and 160 Pumps and motors shall operate at fluid suction temperatures between 0 and 160

3.3.14 Hydraulic fluid.- Pumps and motors shall be designed to operate efficiently using any of the hydraulic fluids specified in Specification MIL-L-15017 or MIL-L-17331, as applicable.

3.3.15 Lubrication.- Pumps and motors shall be self-lubricating by means of the fluid circulating within the case.

3.3.16 Pressure pulsation.- Pumps shall be designed to deliver a steady flow of fluid without pressure pulsation of more than 5 percent above or below continuous rated working pressure. This allowance shall become uniformly less at operating pressures less than rated working pressure.

3.3.17 Vibration and noise.-

3.3.17.1 Class I, II, and III pumps and motors shall be designed and built so as to m inimize vibratory forces which may cause undue vibration, noise and wear.

3.3.17.2 Class IV and V pumps and motors shall be balanced in accordance-with type II (internally excited vibration of Standard MIL-STD-167). The method of applying balance correction shall be left to the discretion of the manufacturer. Vibration measurements shall be extended to cover higher orders of vibration as specified in Standard MIL-STD-167.

3.3.17.3 Noise due to turbulence, rapid change in condition or direction of hydraulic fluid and cavitation in all classes of pumps and motors shall be minimized by proper design.

3.3.18 Weight and dimensions.- Pump and motor design shall provide for keeping overall weight and size at a minimum. The latest methods and materials shall be considered in the design. Determination of acceptable size and weight will be based on equipment previously and presently in service aboard Naval ships.

3.3.19 Painting.- External surfaces of pumps and motors shall be painted for protection and good appearance. Painting, where used, shallconsist of two coats of zinc chromate primer confirming to Specification JAN-P-735, and one coat of enamel in accordance with class 2 of Specification MIL-E-15090. The inside of pump and motor cases, where in contact with hydraulic fluid, shall not be painted.

3.3.20 Shock.- The pump and motor, or both shall withstand the shock test specified in 4.10.18.

3.4 Design detail.-

3.4.1 Class I and class II.-

3.4.1.1 Working pressures.- Class I and class II pumps and motors shall be suitable for continuous working pressures up to and including 3,000 pounds per square inch. Intermittent operation (see 4.10. 5) at 150 percent of rated continuous working pressure shall be possible. It shall also be possible to subject pumps and motors to static pressures equivalent to 200 percent of rated working pressure (see 6.3).

3.4.1.2 Efficiency.- Volumetric efficiency shall be not less than 90 percent and mechanical efficiency not less than 85 percent under full load conditions and at 100° Fahrenheit (F.) oil temperature. At 160°F. oil temperatures (see 3.3. 13), efficiency shall riot drop more than 5 percent.

3.4.1.3 Relief and replenishment valves.- Relief valves shall be included in all pumps. Replenishment valves shall also be included when specified (see 6.1). These valves shall be readily accessible for maintenance and repair.

3.4.1.4 Integral auxiliary pumps.- Where practicable, as determined from size, space and particular application, pumps shall be furnished with integral servo pressure and replenishment pumps. In general, pumps having a 25 horsepower (hp.) rating and higher shall have this feature, Auxiliary pumps shall be operated from the main pump drive shaft by gearing or dependable belt drive.

3.4.1.5 Variable delivery control.- Design of all class I and class II variable delivery pumps shall provide for including reversing control. The bare control stem or lever and related parts shall have low inertia so as to contribute toward use of small and compact manual or automatic control operating devices, Effort to operate the control stem or lever shall be reasonly uniform on either side of no delivery position. This effort shall be kept to a minimum urn so as to be of advantage in designing small and compact control operating mechanisms. The type of control operating device furnished and effort figures shall be as specified (see 6.1). Types of control that may be required are as follows:

(a) Manual push-pull control - This type of control shall consist of a stem, projecting, through the pump case, which can be pushed or pulled manually to regulate pump delivery between maximum and minimum.

(b) Manual rotary handwheel - This type of control shall consist of a lead screw, projecting through the pump case, which is fitted with a handwheel suitable for manual rotation of the screw. By manual rotation of the handwheel, the pump delivery may be regulated between maximum amd minimum.

(c) Hydraulic cylinder control - This type of control shall consist of a hydraulic cylinder actuated by an external pressure source. By metering oil to the cylinder, using an appropriate manually or automatically controlled valve, the pump delivery may be varied between maximum and minimum.

(d) Servo piston control - This type of control shall consist of a booster or amplifier supplied by an external pressure source. Linear or rotary movement of the booster control stern manually or by means of selsyns, solenoids, or other mechanisms as required by the particular application, may control the pump delivery from maximum urn to minim urn.

(e) Servo motor or selsyn control - This type of control shall consist of a lead screw, projecting through the pump case, which is fitted with a reduction gear and a small electric motor or power selsyn. By controlling the operation of the motor or selsyn, the delivery of the pump may be varied from maximum to minimum.

(f) Pressure compensator control - This type of control shall consist of a pressure sensitive device for automatic regulation of pump delivery to the fluid requirements of the system by maintaining pressure at a preadjusted value.

3,4. 1.5.1 All pumps shall have delivery position indicators.

3.4.2 Class III. -

3.4.2.1 Working pressure. - Class III pumps and motors shall be suitable for continuous working pressures up to and including 2,000 pounds per square inch. Intermittent operation at 150 percent of working pressure and static pressure loading at 200 percent of working pressure shall be possible (see 6.3). 3).

3.4.2.2 Efficiency. - Volumetric efficiency shall be in the range of 90 to 95 percent and mechanical efficiency in the range of 85 to 90 percent under full load conditions and at 100°F. oil temperature. At 160°F. oil temperatures (see 3.3. 13), efficiency shall not drop more than 5 percent.

3.4.2.3 Integral auxiliary pumps. - Class III pumps shall be furnished with integral auxiliary pumps for generation of control and replenishing pressure only when specified (see 6. 1).

3.4.2.4 Variable delivery control. - Class III pumps shall be constant delivery type but the contract or order may specify variable delivery control in accordance with 3.4.1.5, according to the particular application (see 6.1).

3.4.2.5 Instant operation. - Means shall be provided for insuring that vanes in pumps and motors will be in correct position for instant operation at working pressure, particularly during cold weather starting. Ambient temperatures at which pumps will motors will be required to start will range between 0° and 110°F.

3.4.3 Class IV. -

3.4.3.1 Working presssure. - Class IV pumps and motors shall be suitable for continuous working pressures up to and including 1500 p.s.i. Intermittent operation of 150 percent of working pressure and static pressure loading at . 200 percent of working pressure shall be possible (see 6.3). 3).

3.4.3.2 Efficiency. - Volumetric efficiency shall be in the range of 90 to 95 percent and mechanical efficiency in the range of 80 to 85 percent under full load conditions and at 100 “F. oil temperature. At 160°F. oil temperatures (see 3.3.13), efficiency shall not drop more than 20 percent.

3.4.3.3 Pump or motor element. - The pumping or torque transmitting element of class IV pumps and motors shall be spur, helical or herringbone gears or may be lobes driven by a timing gear arrangement.

3.4.3.4 Wear plates. - Class IV pumps and motors designed for high pressure operation shall have wear plates on the faces of gears to compensate for wear, Gears shall be cut and hardened to provide for long, efficient life.

3.4.3.5 Axial thrust balance. - Design shall include an arrangement for hydraulically balancing the pump or motor element to minimize axial thrust where the pump or motor is used for high pressure service.

3.4.4 Class V. -

3.4.4.1 Working pressure. - Class V pumps shall be suitable for continuous working pressures up to and including 3,000 p. psi. Intermittent operation at 150 percent of working pressure and static pressure loading at 200 percent of working pressure shall be possible (see 6.3).

3.4.4.2 Efficiency. - Volumetric efficiency shall be at least 60 percent and mechanical efficiency at least 50 percent when operating at design working pressure, rated speed, and using the specified hydraulic oil at 130 at 160°F. oil temperatures (see 3.3.13), efficienies shall not drop more than 10 percent,

3.4.4.8 Pump element. - The pump shall consist of a power rotor that moves the oil and idle rotors for sealing purposes,

3.4.4.4 Seal. - The seal on the output shaft shall be a mechanical type, The leakage shall not exceed 10 drops per hour, at 30 p.s.i. case pressure after initial break-in period, when the pump is operated at design capacity.

3.4.4.5 Axial thrust bearing. - Design shall include an arrangement for hydraulically balancing the pump or motor element to minimize axial thrust where the pump is used for high pressure service.

3.4.4.6 Material. - Materials having an elongation of less than 5 percent in a 2 inch sample will not be acceptable for class V pumps,

3.4.4.7 Hydraulic fluid. - Hydraulic fluid in accordance with Specification MIL-L- 17331 shall be applicable for class V pumps with design pressures a o 1500 pounds per square inch (p.s.i.). Below design pressures of 1,500 p.s.i., Military symbol oil 2075 in accordance with Specification MIL-15017 shall be applicable.

3.4.4.8 Noise. - The class V pump is primarily designed for use in submarine hydraulic systems and therefore a low noise output of the pump should be a major design consideration.

3.4.4.9 Vents and drains. - Case design shall include necessary connections for vent and draining purposes and seals capable of withstanding 60 p.s. i. supercharge pressure.

3.4.5 Miscellaneous details - hydraulic motors. -

3.4.5.1 Displacement. - All motors shall have a fixed displacement unless otherwise specified (see 6.1).

3.4.5.2 Low inertia. - Hydraulic motors shall be designed for low inertia so as to result in the best possible time constant for the particular size.

3.4.5.3 Minimum steady speed. - It shall be possible to operate all classes of hydraulic motors with connected load at a steady speed of as low as 50 r.p.m. operation of the motor and connected load at such speed shall be smooth and steady.

3.5 Identification plates, special marking. - Each pump and motor shall have identification marking in accordance with Standard MIL-STD-130. Special markings, such as direction of rotation and port marking, shall also be included as necessary. All plates used for marking shall be in accordance with Specification MIL-I-15024.

3.6 Repair parts. -

3.6.1 Onboard repair parts. - Onboard repair parts sets shall consist of such items as gaskets, seals, springs, vanes and bearings which are easily replaced in the pump or motor by personnel of limited mechanical experience. Quantities of each item shall be sufficient for maintenance of the unit for a period of one year.

3.6.2 Stock repair parts. - When specified (see 6. 1), stock repair parts shall be furnished in accordance with Specification MIL-R-15137.

3. .3 Repair parts list format. - The format for repair parts lists shall be as shown in specification MIL-F -17292. Lists shall be attached to the certification data sheet specified in 3.7.

3.7 Drawings. - Outline, assembly and subassembly drawings shall be f urnished. Outline or installation drawings shall include a performance curve. All drawings shall be type I in accordance with Specification MIL-D-963. Certification data sheets shall be furnished. Approval of drawings shall be by the bureau or agency concerned or its field representative as specified (see 6.1).

3.8 Technical manuals. - Type C technical manuals as defined in Specification MIL-T- 15071 shall be furnished. Where appropriate, the manuals may be prepared for insertion as a section of another book which may describe machinery that includes the pum P or motor as a sub-corn ponent. The technical manual shall also include an exploded view of the pump or motor.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection reports. - The Government inspector shall furnish the bureau or agency concerned with inspection reports covering results of group C tests only (see 4.2. 4) unless otherwise specified (see 6. 1).

4.2 Sampling for lot acceptance. -

4.2.1 Lot definition. - For sampling purposes, a lot shall consist of all pumps or motors of the same class and size offered for delivery at one time.

4.2.2 Sampling for group A tests. - A random sample of pumps Or motors shall be selected in accordance with table I from each inspection lot by the Government inspector and shall be subjected to each of the group A tests specified in 4.3.1 with lot acceptance based on the following sampling requirements in accordance with Standard MIL-STD-105:

Table I - Sampling for group A tests
AQL (approx.) = 1, 5 percent defective,

Number of pumps or motors in inspection lot	Number of pumps or motors in sample	(Number of equipments nonconforming on any group A test)	
		Acceptance number	Rejection number
2 to 8	6	0	1
9 to 15	8	0	
16 to 25	10	0	1
26 to 40	13	0	
41 to 65	17	0	1
66 to 110	22	1	2
111 to 180	28	1	2
181 to 300	35	1	2
301 to 500	45	2	3
501 and over	55	3	4

4.2.3 Sampling for group B tests. - A random sample of pumps or motors shall be selected from each inspection lot by the Government inspector in accordance with table II and shall be subjected to each of the group B tests specified in 4.3.2.

Table II - Sampling for group B tests.

Number of pumps or motors in inspection lot	Number of pumps or motors in sample	(Number of equipments nonconforming on any group B test)	
		Acceptance number	Rejection number
2 to 8	3	0	1
9 to 15	4	0	1
16 to 25	5	0	1
26 to 40	6	0	1
41 to 65	8	0	1
66 to 110	10	0	1
111 to 180	13	1	2
181 to 300	17	1	2
301 to 500	22	2	3
501 and over	28	2	3

4.2.4 Sampling for group C tests. - A sample number of pumps or motors in accordance with table III shall be selected by the Government inspector from the total num ber under the contract and shall be subjected to group C tests specified in 4.3.3. (Group C tests are intended as a periodic quality check on the manufacturer's product) (see 4.12).

Table III - Sampling for group C tests.

Number of pumps or motors on the contract	Number of pumps or motors to be selected for group C tests
65 and under	1
66 to 300	2
301 to 800	3

4.3 Lot acceptance tests. -

4.3.1 Group A tests. - Each of the sample pumps or motors selected in accordance w ith table I shal l be subjected to each of the following tests which shall be conducted or witnessed by the Government inspector, and the results of each test compared with this specification. Failure to conform to this specification for any group A test shall be counted as a defect and the pump or m otor shall be rejected. If the number of such nonconforming pumps or motors in any sample exceeds the acceptance num ber for that sample, the lot represented by 'the sample shall be rejected. Rejected lots may be offered again for Government inspection tests provided all pumps or motors in the lot have been retested by the contractor for test(s) causing rejection and all noncompliance corrected.

Group A tests	Reference
Visual inspection	4.10, 1
Noise (by ear)	4,10.2
Vibration (by touch)	4.1003
Minim um constant speed (hydraulic motors only)	4. 10.16

4.3.2 Group B tests. - Each of the sample pumps or motors selected in accordance with table shall be subjected to each of the following tests which shall be conducted or witnessed by the Government inspector, and the results of each test compared with this specification. Failure to conform to this specification for any group B test shall be counted as a defect and the pumps or motors shall be rejected. If the number of such nonconforming pumps or motors in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall ne rejected. Rejected lots may be offered again for Government inspection tests provided all pumps or motors in the lot have been retested by the contractor for the test (s) causing rejection and all noncompliance corrected

Group B tests	Reference
Load and efficiency	4.1004
Overload	4. 10.5
Volumetric efficiency	4.10.6
Stroke control effort (variable pumps)	4.10.7

4.3.3 Group C tests. - Each of the sample pumps or motors selected in accordance with table III shall be subjected to each of the following tests and the results of each test compared with this specification. In the event of any failure to conform to this specificati on for any group C test the contractor shall correct the cause of failure on future production units and repair the deficiency in any pumps or motors not yet shipped. Shock tests may be waived for pumps or motors where identical pumps or motors have been successfully shock-tested, Where the shock tests have taken place, the manufacturer shall submit a copy or the test report before waiver of the shock test will be given:

Group C tests	Reference
Vibration and noise	4.10.13
Endurance	4.10.14
Time constant (hydraulic motors only)	4.10.15
Shock	4.10.17

4.4 Classification of tests. - Inspection and testing of hydraulic pumps and m otors for Naval shipboard use shall be classified as follows:

(a) Qualification tests (see 4.12).
(b) Inspection tests - Tests performed on pumps and motors manufactured and submitted for acceptance under a contract or order. Inspection tests and frequency of such tests shall be as specified in 4.3.

4.5 Test nomenclature and definitions. - Definitions of test terms and nomenclature to be used are as follows:

(a) Designed working pressure is the nominal pressure rating assigned by the manufacturer of the equip-m ent for continuous service.
(b) Maxim um designed pressure is the pressure permitted for in term inttently applied loads (normally 150 percent of designed working pressure).
(c) Base r.p.m. is the designed r.p.m. of the pump or motor.
(d) Actual r.p.m. is the r.p.m. at which the test is actually conducted.
(e) Corrected gallons per minute (g.p.m.) is the rate of discharge during the test as referred to the base r.p.m.

$$\text{ed g. p. m.} = \frac{\text{g. p. m. x actual r. p. m.}}{\text{Base r. p. m.}}$$

(f) Indicated torque is the torque as indicated by a torquemeter.

(g) Horsepower input is ind. $\frac{\text{torque x base r. p.m.}}{5250}$

(h) Horsepower output is corr. g. p. m. x 0.000583 x p. s. L

(i) Overall efficiency is the horsepower output divided by the horsepower input.

4.6 Test conditions. -

4.6.1 Tests specified hereinafter will be based on:

(a) A sample constant or variable delivery pump loaded by throttling the discharge port, using a heat exchanger, where necessary, to maintain proper operating temperature (see 3.3.10) or,

(b) A sample matched constant or variable delivery pump and hydraulic motor operating as a transmission and loaded by m cans of a dynamometer. Under either condition, the pumps shall be driven at designed speed and delivery rate through a torquemeter by a suitable electric motor.

4.6.2 Tests shall be performed in the order specified in 4.10.

4.6.3 During each of the tests for classes I, II, III, and IV pumps, the s uction oil temperature shall be maintained as near constant as practicable at between 90° and 100 For class V pumps the suction oil temperature shall be maintained at 130 These temperatures shall be maintained through all tests, except those specified in 4.10.11 and 4.10.12. Each test shall be conducted at the following suction pressures: (1) 20 p.s.i. (2) 0 inch Hg. (3) 10 inch Hg.

4.6.4 Oil temperatures shall be measured by means of a thermometer which has been securely fastened in direct contact with the main pressure pipe near the pump. Additional test thermometers may be secured at other locations in the hydraulic circuit as desired.

4.6.5 Measurement of fluid flow shall be accomplished by means of a positive displacement meter with an accuracy of at least 99 percent or by appropriate weighing equipment.

4.6.6 Oil pressure shall be determined by m cans of calibrated dial pressure gages of the Bourdon type.

4.6.7 Noise measurements during each test shall always be made under the same conditions. Air -borne noise shall be measured at several locations about the test specimen at a distance of 3 feet from the location, Several structure noise measurements shall be made on the specimen structure using a suitable probe.

4.7 Descriptive data. - The following data shall be noted and recorded for transmittal with the information specified in 4.8 and 4.9:

(a) Pump data - (Omit items not applicable.)
- (1) Manufacturers designation, size and type of pumps.
- (2) Bore of cylinders.
- (3) Number of pistons, vanes or gear data.
- (4) Material used in construction, all parts.
- (5) Type of bearings.
- ($) Rated working pressure and allowable overload.
- (7) Displacement at rated working pressure - Cubic inches per revolution.
- (8) Speed rating (r.p.m.).
- (9) Stroking method.
- (10) Maxim urn angle of piston rod tilt plate.
- (11) Source of pressure if servo stroked.
- (12) Grade of oil used (Military symbol).
- (13) Manufacturers tern perature limits.
- (14) Weight.
- (15) Type of pipe connections and seals.

(b) Hydraulic motor data - (Omit items not applicable.)
- (1) Manufacturers designation, size and-type of motor.
- (2) Bore of cylinders.
- (3) Number of pistons, vanes or gear data.
- (4) Material used in construction, all parts.
- (5) Type of bearings.
- (6) Rated working pressure and allowable overload.
- (7) Manufacturer's torque rating.
- (8) Displacement at rated working pressure - Cubic inches per revolution.
- (9) Maximum and minimum urn speed rating (r.p.m.).
- (10) Angle of piston rod tilt plate.
- (11) Grade of oil used (Military symbol).
- (12) Manufacturers tern perature limits.
- (13) Weight.
- (14) Type of pipe connections and seals.

4.8 Technical data required. - Test data shall be furnished the bureau or agency concerned which shall present graphically, the following data: (Omit items not applicable.)

(a) Mechanical and volumetric efficiency on a discharge pressure base for runs at 25, 50; 75, 100 and 150 percent of the maxim um designed normal working pressure and where applicable, at 1/4, 1/2, 3/4 and full stroke on each side of neutral for each pressure.
(b) Horsepower input on the discharge pressure base using torquemeter readings and speed in r.p.m. for runs as specified in 4.8 (a).
(c) Horsepower output on a discharge pressure base for runs as specified in 4.8 (a).
(d) Torque output of the hydraulic motor on a pump discharge pressure base for runs as specified in 4.8 (a).
(e) Fluid flow in g. p.m. for discharge pressures of 25, 50, 75, 100 and 150 percent of maxim um designed normal working pressure.
(f.) Effort required to set pump on stroke shown on a pressure base up to designed normal working pressure for 1/4, 1/2, 3/4 and full stroke on each side of neutral. Time cons um ed in arriving at the various points shall be indicated on these curves.
(9) Time to accelerate hydraulic motor to maxim um intermittent speed on a speed base.
(h) Percent of pump pulsation on a pressure base.
(i) Noise and vibration spectra.

4.9 Technical report required. - The bureau or agency concerned shall be furnished a written report along with the data and information as specified in 4.7 and 4.8 which shall contain the following:

(a) Temperature of suction oil during test.
(b) Type of oil used - Military symbol.
(c) Description of circuit used during test.
(d) Performance during 30 degree inclination of test unit.
(e) Minim urn steady speed and time constant for hydraulic motor.
(f) Performance during hot and cold oil tests. Items such as effi ciency, lubrication, time to start shall be included.
(g) Statement as appropriate, on status of noise and vibration.

(h) Results of shock test.
(i) Condition of pump m otor after all test.
(j) Discussion and recommendations of test activity.
(k) Operation during lubrication test.

4.10 Test procedures. -

4.10.1 Visual inspection. - Inspect the pump or motor for best manufacturing practice, conformance to applicable drawings and any specification requirements not covered by tests.

4.10.2 Noise (by ear). - Operate pump or motor at full capacity and designed working pressure for 5 minutes. Note any excessively unusual noise.

4.10.3 Vibration (by touch). - While operating the pump or motor as specified in 4.10.2, note for vibration which appears excessive by comparison with other pumps and motors in the inspection lot.

4.10.4 Load and efficiency tests. -

(a) Operate pump or motor 30 minutes at rated speed, full volume and at 25, 50, 75 and 100 percent of designed working pressure. Note data as specified in 4.8 at 5-minute intervals and at end of test. Variable delivery pumps shall be operated 15 minutes on each side of neutral at full volume under specified conditions.
(b) Operate variable delivery pumps 5 minutes on each side of neutral at rated speed and 1/4, 1/2 and 3/4 full stroke and at 25, 50, 75 and 100 percent of designed working pressure, noting data as specified in 4.8 at start and end of test.

4.10.5 Overload test. - Operate pump or motor for 5 minutes at full volume at 150 percent of designed working pressure noting data as specified in 4.8. Variable delivery pumps shall be operated 5 minutes on each side of neutral under conditions specified.

4.10.6 Volumetric efficiency (leakage) test. - Operate pump or motor at full volume and 25, 50, 75 and 100 percent of designed working pressure sufficiently to determine leakage in g.p.m. into the unit case. Note data as specified in 4.8. Variable volume pumps shall be operated on one side of neutral only at 1/4, 1/2 and 3/4 as well as full stroke.

4.10.7 Stroke control effort (variable delivery pumps only). - The base pump shall be tested to determ ine the effort required to manually move the stroke adjusting mechanism from zero to full stroke on each side of neutral when working at pressure at 25 50, 75 and 100 percent of the designed working "pressure. Note data as specified in 4.8.

4.10.8 Lubrication (no-stroke)test (class I and II pumps only). - Operate pump for 30 minutes continuously at no stroke position. and designed dive speed during which time no oil shall be pumped and the head of oil of the suction port shall not exceed 5 feet. At 5- minute intervals during this test the pump shall be brought to a full stop and im mediately restarted. Note applicable data as specified in 4.9.

4.10.9 Inclination test. - Rotate the pump or motor 30 degrees clockwise around its vertica axis and operate at full volume and designed working pressure for 10 minutes Repeat for counterclockwise direction_. Note applicable data as specified in 4. 9.

4.10.10 Pulsation test. - The pum p shall be operated at full volume and 25, 50, 75 and 100 percent of designed working pressure for 10 minutes at each setting. Using the manufacturer's designed working pressure as a mean and appropriate measuring devices, measure the average pressure deviation from mean at 2-minute intervals. Oil for this test shall be deaerated to the maximum practical extent. Report data as specified in 4.8. Measuring device pickup shall be located in the high pressure line at a distance 3 feet from the pump.

4.10.11 Cold oil test. - The oil used for this test and the test unit shall be subjected to a temperature of 0°F. so that the oil entering the suction side of the unit will be mainted at this temperature for the duration of the test. Start and gradually load the unit to designed capacity, Operate in this manner for 10 minutes. Note and record data as specified in 4.9 (f) at 5 minute intervals.

4.10.12 Hot oil test. - The oil used for this test snail be subjected to a tem perature of 160°F. so that the oil entering the suction side of the test unit will be maintained at this temperature for the duration of the test. Start and load test unit gradually to designed capacity. Operate in this manner for 10 minutes. Note and record data as specified in 4.9 (f) at 5 minute intervals.

4.10.13 Vibration and noise test. -

4.10.13.1 The test of acceptability for class I, II and III pumps and motors from a vibration and noise standpoint shall be vibration and noise not in excess of that from pumps and mo operated under similar controls of the same class and size produced by com petitive manufacturers and successful conclusion of all applicable tests required t this specification.

4.10.13.2 Class IV and V pumps and motors shall meet the vibration and noise requirements of 3.3.17.2.

4.10.14 Endurance test. -

4.10.14.1 Variable delivery pumps. - Operate at designed working pressure and at 1/4, 1/2, 3/4 and full stroke for 24 hours at each setting. During operation at each setting the pump shall be cycled from one side of neutral to the other every 15 minutes (four cycles per hour). Note items such as mechanical and volumetric efficiency, noise, vibration and oil tern perature at start of test, at one-hour Intervals during test and at end of test. Report as specified in 4.9.

4.10.14.2 Constant delivery pumps and motors. - Operate at designed working pressure and rated speed for 100 hours continuously. Near the start and end of this test, operate for short duration at 25, 50 and 75 percent of designed working pressure. Note items and report as specified in 4.9.

4.10.15 Time constant test (hydraulic motors only). - From a stand-still, accelerate hydraulic motor less external load to maximum intermittent speed, Repeat 3 times. Report as specified in 4.8,

4.10.16 Minimum constant speed test (hydraulic motors operating from variable delivery pumps only). - Reduce output of pump to where speed of hydraulic motor is 50 r.p.m. with rated external load at that speed. Operate in this manner for 10 minutes. Report as specified in 4.9

4.10.17 Shock test. - The pump and motor or both shall be subjected to a type A high-impact shock test in accordance with Specification MIL-S-901. During the test the unit shall be operated at designed working pressure. The unit shall be mounted on the table of the shock machine, using fitted foundation bolts. Mounting shall simulate shipboard conditions insofar as practicable, Report as specified in 4,9.

4.11 Rejection. - Items which shall be considered as cause for rejection after tests as specified in 4.3 are summarized as follows:

(a) Imperfections such as misalignment, poor painting or other corrosion protection and any deviation from this specification as revealed by visual inspection (see 4.10.1).
(b) Unusual noise or vibration by comparison with other pumps or motors in the inspection lot (see 4.10.2 and 4.10.3).
(c) Failure to meet efficiency requirements (see 3.4.1.2, 3.4.2.2, 3.4.3.2 and 4.10.4).

(d) Failure to perform satisfactorily on overload test (see 4.10.5).
(e) Excessive leakage (see 3.4.1.2, 3.4.2.2, 3.4.3.2 and 4.10. 6).
(f) Nonsymmetrical stroke control effort for each side of neutral (see 3.4.1.5 and 4.10.7).
(g) Heating of pump or motor parts or temperature rise in hydraulic fluid during lubrication test in excess of 160°F. (see 3.3.13 and 4.10.8).
(h) Any marked change in performance during inclination test (see 4.10.9).
(i) Pulsation in excess of 5 percent (see 3.3.16 and 4.10.10),
(j) Labored starting during cold oil test (see 4.10.11).
(k) Drop in efficiency in excess of allowance during hot oil test (see 3.4.1.2, 3.4.2.2, 3.4.3.2 and 4.10.12).
(l) Excessive wear of parts on completion of endurance test, Excessive wear shall be that which is sufficient to reduce pump performance and that which would indicate short life of the pump or motor.
(m) Excessive time to accelerate hydraulic motor. Generally, anything in excess of 0.1 second for any size motor will be considered excessive (see 4.10.15).
(n) Erratic operation of hydraulic motor at 50 r.p.m. (see 4.10.16).
(0) Breakage or malf unctioning of pump or motor as defined in Specification MIL-S-901 during shock test (see 3.3.20 and 4.10.17).
(p) Squeal and chatter determined to be of hydraulic origin (see 3.3.17).
(q) Excessive weight and size (see 3.3.18).

4.12 Qualification tests at a laboratory. - Qualification tests shall be conducted at a laboratory designated by the Bureau of Ships. These tests shall consist of the tests specified in 4.10.

4.13 Inspection procedures. - For Naval purchases, the general inspection procedures shall be in accordance with General-Specifications for Inspection of Material.

5. PREPARATION FOR DELIVERY

5.1 Basic requirements. - Pumps and hydraulic motors, repair parts, drawings and technical manuals shall be preserved, packaged packed and marked for dom estic shipment - immediate use, domestic shipment and storage as stock or for overseas shipment as specified (see 6.1). Methods and materials shall be as specified in Specification MIL-P- 16789 except that part which pertains to the use of perservatives on the internal surfaces of hydraulic pumps and motors intended f or domestic shipment - immediate use.

5.2 Internal preservation for domestic shipment - immediate use. - Internal preservation shall be by the use of hydraulic equipment preservative oil conforming to Specification MIL-O-6083. This oil shall be thoroughly, worked into the pump or motor by operting for short intervals. The oil shall be drained and all openings sealed and locked in the manner specified for flange bolts and nuts oil hydraulic pumps and motors in Specification MIL-P-16789 prior to shipment. Internal protection afforded by using preservative conforming to Specification MIL-O-6083 shall be limited to one year. Pumps and motors protected from corrosion inthis manner shall be conspicuously labeled on the unit package and shipping container to indicate date of preservation and to warn that re-preservation is required at the expiration of one year.

5.3 Special precautions during preservation and handling. - Care shall be taken to prevent the entry of material such as sand, grit, metal chips and spatter into the pump or motor during the preservation process and when handling between the manufacturer and the prime contractor where such parties are involved. When the original preservation is destroyed due to testing of the equipment by the prime contractor, it shall be restored to the original condition prior to delivery to the Government.

6.4 Marking. - In addition to any special marking specified in the contract or order, interior packages and shipping containers shall be marked in accord-
. ante with Standard MIL-STD- 129.

6. NOTES

6.1 Ordering data. - Procurement documents should specify the following

(a) Title, number, and date of this specification.
(b) Class, size duty and performance required (see 1.2, 3.3.1 and 3.3.2).
(c) Mountugn method for hydraulic pumps and motors (see 3.3.5.1 and 3.3.5.2).

(d) Whether splined or keyed shafts are required (see 3.3.7)
(e) Whether replenishing valve is required (see 3.4.1.3).
(f) Type of pump control required (see 3.4.1.5).
(g) Integral auxiliary pump required with class III pump (see 3.4.2.3 and 3.4.2.4).
(h) State if variable hydraulic motor required (see 3.4.5.1).
(i) Whether stock repair parts are required (see 3.6.2).
(j) Draw ing approval activity (see 3.7).
(k) State if other than group C tests reports required (see 4.1).
(l) Whether for domestic shipment - immediate use; domestic shipment and storage, or overseas shipment (see 5.1).

6.2 Qualification.- With respect to products requiring qualification, aw ards will be made only for such products as have, prior to the bid opening date, been tested and approved for inclusion in Qualified Products List QPL-17869, whether or not such products have actually been so listed by that date. Manufacturers are urged to communicate with the Chief of the Bureau of Ships, Department of the Navy, Washington 25, D. C. and arrange to have the products that they propose to offer tested for qualification.

6.3 The 200 percent static pressure specified in 3.4.1.1, 3.4.2.1, 3.4.3.1 and 3.4.4.1 shall apply only to the parts of the pumps or motor which are subjected to designed working pressure.

Patent notice.- When Government drawings, specifications, or other data are used for any purpose other ‘than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government m ay have form ulated, furnished, or in any way supplied the said drawings, specifications or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Custodian:
Bureau of Ships

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION

ORGANIZATION *(Of submitter)* | CITY AND STATE

CONTRACT NO. | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT
$

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)* | DATE

DD FORM 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE PLATE NO. 15419

FOLD

DEPARTMENT OF THE NAVY

POSTAGE AND FEES PAID
NAVY DEPARTMENT

OFFICIAL BUSINESS

CHIEF, BUREAU OF SHIPS
ATTN: CODE 621
DEPARTMENT OF THE NAVY
WASHINGTON, D. C. 20360

FOLD